PASSAIC COUNTY TECHNICAL INSTITUTE
45 Reinhardt Rd.
Wayne, NJ

AP Computer Science IV (CS AP)
COURSE NUMBER: 2198
CREDITS: 17.5
2018

I. COURSE DESCRIPTION:

AP Computer Science is College Board course. This course introduces the student to the object-oriented programming paradigm using Java language. The standard Java library classes from AP Java subset is used. Applications of the following concepts: classes, objects, inheritance, polymorphism, and code reusability are implemented. Hands-on laboratory work will be done to solidify each concept.

II. UNITS:

UNIT 1

Content Area:	AP Computer Science IV	Grade(s)	12
Unit Plan Title:	**JAVA BASICS** **I. Background (week 1)** **1.** History of Computers **2.** Computer hardware and Software **3.** Programming Languages **4.** The Software Development Process **5.** Basic Concepts of Object - Oriented Programming *Sample Student Activity* Research paper on Water model, Software development life cycle **II. First Java Program (week 2, 3)** **1.** The JVM and Byte Code **2.** Hello World **3.** Edit, Compile, and Execute a program *Sample Student Activity* Practice pseudocode and flowchart; Hello World; display name and address; yield sign within a triangle; display county flags; temperature conversion **III. Syntax, Errors, and Debugging (week 4, 5)** **1.** Language elements **2.** Basic Java Syntax and Semantics **3.** Terminal I/O for different Data Types **4.** Comments **5.** Programming Errors **6.** Debugging *Sample Student Activity* Miles – kilometer conversion; calculate minutes in a year; income tax calculator; circumference, surface area and volume of sphere; kinetic energy of a moving object; compute employee's weekly pay		

IV. Introduction to control Statements (week 6, 8)

1. Additional Operators
2. Standard Classes and Methods
3. The *if* and *if-else* Statements
4. The *fo*r Statements
5. Nested Control Statements and the *break* Statements
6. Using loops

Sample Student Activity

Lucky seven dice playing program; quotient and remainder; check whether a right triangle; cost of a phone call; teacher's salary based on their year of experience

V. Introduction to Defining Classes (week 9, 11)

1. The internal structure of Classes and Objects
2. A *student* class
3. Editing, Compiling, and Testing the *student* class
4. The Structure and Behavior of Methods
5. Scope and Lifetime of Variables

Sample Student Activity

Student class; bank account class, library patron class

VI. Control Statements Continued (week 12, 14)

1. Logical Operators
2. Testing *if* Statements
3. Nested *if* statements
4. Logical Errors in Nested *if* statements
5. Nested Loops
6. Testing Loops
7. Loop verification
8. Advanced operation on Strings

Sample Student Activity

Compute weekly pay; student's grade; sales commission; counting words in a sentence; guessing game; numeric/letter grade

VII. Improving the User Interface (week 15, 16)

1. Repeating sets of Inputs

	2. A Menu-Driven Conversion Program 3. Formatted Output with *printf* and *format* 4. Handling Number Format Exceptions During Input *Sample Student Activity* Thermometer class; temperature conversion revisit

NJSLS/CCTC Standard(s) Addressed

CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.
9.3. IT.2 Use product or service design processes and guidelines to produce a quality information technology (IT) product or service
9.3. IT-PRG.1 Analyze customer software needs and requirements.
9.3. IT-PRG.2 Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
9.3. IT-PRG.4 Demonstrate the effective use of software development tools to develop software applications.
9.3. IT-PRG.5 Apply an appropriate software development process to design a software application.
9.3. IT-PRG.6 Program a computer application using the appropriate programming language.
9.3. IT-PRG.7 Demonstrate software testing procedures to ensure quality products.
9.3. IT-PRG.8 Perform quality assurance tasks as part of the software development cycle.

Essential Questions (3-5)

1. How can a program to convert the temperature from Celsius to Fahrenheit be written?
2. How can programs using different methods of String class be written?
3. How can programs using different repetition statements be written?

Anchor Text(s)

- *Blue Pelican Java* Charles E. Cook, Online Textbook
  ISBN: 1589397584
  http://www.bluepelicanjava.com

- *Java software Solutions* – 3rd Edition, Lewis, Loftus, Cocking
  ISBN: 978013
  http://www.bluepelicanjava.com

Short & Informational Texts (3-5)

INFORMATIONAL MATERIAL

- *Introduction to Computer Science using Java* http://chortle.ccsu.edu/java5/cs151java.html
  Bradley Kjell, 2006. Central Connecticut State University
  (Referred to as Kjell)

- College Board. *Labs* https://apcentral.collegeboard.org/courses/ap-computer-science-a/classroom-resources/lab-resource-page

Expected Proficiencies/Career and Life Skills

PROFICIENCIES:

- Describe the steps involved in java program compilation and execution
- Know the deference between primitive data and objects
- Able to create objects and use them
- Define the flow of control through a program
- Learn to use *if* statements
- Learn to use *while* and *for* statements
- Use method overloading and method overriding

LIFE SKILLS:

- Students will have a good understanding of Java

Formative & Summative Assessments

FORMATIVE:

- Hands-on lab work
- In-class discussions

- Quizzes
- Questioning and discussion

SUMMATIVE:

- Projects/Presentations
- End-of-unit or chapter tests
- End-of-term or semester exams

Resources (Websites, LMS, Google Classroom, documents, etc.)

- Lynda.com
- Canvas
- YouTube videos
- w3schools.com

Suggested Time Frame : 16 weeks

UNIT 2

Content Area:	**AP Computer Science IV**	**Grade(s)**	**12**
Unit Plan Title:	**ARRAYS AND ARRAYLIST** **I. Introduction to Arrays (week 17-18)** 1. Conceptual Overview 2. Simple Array Manipulations 3. Looping Through Arrays 4. Declaring Arrays 5. Working with Arrays that are not full 6. Parallel Arrays 7. Using the Enhanced *for* loop 8. Arrays and Methods 9. Arrays of Objects		

Sample Student Activity
Manipulating int arrays; sum / count occurrences; student test scores

II. Classes Continued (week 19-21)

1. Class *(static)* variables and methods
2. Code reuse through Inheritance
3. Working with Arrays of Objects
4. Inheritance and Abstract Classes
5. Interface, Inheritance and Relationship among Classes
6. Acceptable Classes for parameter and return values
7. Exceptions
8. Reference types, Equality and Object Identity

Sample Student Activity
Hierarchy of classes representing the classification of artifacts; shape hierarchy; bank account hierarchy

III. ArrayList (week 22-24)

1. Declaring, constructing, initializing and indexing ArrayList
2. Storing primitive objects in ArrayList
3. Traversing, inserting, deleting ArrayList elements
4. Passing ArrayList to Methods
5. Wrapper Classes – Double, Integer

Sample Student Activity
ArrayList class

NJSLS/CCTC Standard(s) Addressed

CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.
9.3. IT.2 Use product or service design processes and guidelines to produce a quality information technology (IT) product or service
9.3. IT-PRG.1 Analyze customer software needs and requirements.
9.3. IT-PRG.2 Demonstrate the use of industry standard strategies and project planning to meet customer specifications.

9.3. IT-PRG.4 Demonstrate the effective use of software development tools to develop software applications.
9.3. IT-PRG.5 Apply an appropriate software development process to design a software application.
9.3. IT-PRG.6 Program a computer application using the appropriate programming language.
9.3. IT-PRG.7 Demonstrate software testing procedures to ensure quality products.
9.3. IT-PRG.8 Perform quality assurance tasks as part of the software development cycle.

Essential Questions (3-5)

1. Why are wrapper classes important?
2. What is the difference between inheritance and interface?
3. How are 1D and 2D arrays manipulated?

Anchor Text(s)

- *Blue Pelican Java* Charles E. Cook, Online Textbook
  ISBN: 1589397584
  http://www.bluepelicanjava.com

- *Java software Solutions* – 3rd Edition, Lewis, Loftus, Cocking
  ISBN: 978013
  http://www.bluepelicanjava.com

Short & Informational Texts (3-5)

INFORMATIONAL MATERIAL

- *Introduction to Computer Science using Java* http://chortle.ccsu.edu/java5/cs151java.html
  Bradley Kjell, 2006. Central Connecticut State University
  (Referred to as Kjell)

- College Board. *Labs* https://apcentral.collegeboard.org/courses/ap-computer-science-a/classroom-resources/lab-resource-page

Expected Proficiencies/Career and Life Skills

PROFICIENCIES:

- Define and use arrays
- Describe how arrays and array elements are passed as parameters
- Learn to use multidimensional arrays
- Examine the ArrayList class
- Derive new classes from existing class
- Add and modify methods in child classes
- Define inheritance, encapsulation and polymorphism.

LIFE SKILLS:

- Students will be having in-depth understanding of object oriented concepts.

Formative & Summative Assessments

FORMATIVE:

- Hands-on lab work
- In-class discussions
- Quizzes
- Questioning and discussion

SUMMATIVE:

- Projects/Presentations
- End-of-unit or chapter tests
- End-of-term or semester exams

Resources (Websites, LMS, Google Classroom, documents, etc.)

- Tutorialspoint.com
- geeksforgeeks.org
- Instructional Videos
- Canvas

Suggested Time Frame : 8 weeks

UNIT 3

Content Area:	AP Computer Science IV	Grade(s)	12
Unit Plan Title:	**DATA STRUCTURE** **I. Recursion, Searching and Sorting (week 25 - 27)** **1.** Recursion **2.** Big O **3.** Insertion and Selection Sorts **4.** Merge sort **5.** Sequential Search **6.** Binary Search *Sample Student Activity* Worksheets and sample source code—sorting, searching, recursion, counting iterations, analysis **REVIEW** **I. Review for AP Exam (week 28 - 32)** 1. Revisit all topics 2. Practice Free Response from past years 3. Practice Multiple Choice 4. Practice Exams *Sample Student Activity* Analyze different search and sort algorithms. Sample exam problems from 2010-2018. Review book sample exams.		
NJSLS/CCTC Standard(s) Addressed			
CRP2. Apply appropriate academic and technical skills.			

CRP4. Communicate clearly and effectively and with reason
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.
9.3. IT.2 Use product or service design processes and guidelines to produce a quality information technology (IT) product or service
9.3. IT-PRG.1 Analyze customer software needs and requirements.
9.3. IT-PRG.2 Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
9.3. IT-PRG.4 Demonstrate the effective use of software development tools to develop software applications.
9.3. IT-PRG.5 Apply an appropriate software development process to design a software application.
9.3. IT-PRG.6 Program a computer application using the appropriate programming language.
9.3. IT-PRG.7 Demonstrate software testing procedures to ensure quality products.
9.3. IT-PRG.8 Perform quality assurance tasks as part of the software development cycle.

Essential Questions (3-5)

1. How can one write a method for searching an array?
2. How can one perform different sorts at given positions in arrays?
3. What is meant by to understand the time efficiency of each sort and search?

Anchor Text(s)

- *Blue Pelican Java* Charles E. Cook, Online Textbook
  ISBN: 1589397584
  http://www.bluepelicanjava.com

- *"Multiple Choice and free response questions in preparation for AP CS A exam"*
  ISBN: 978-1-934780-34-3

Short & Informational Texts (3-5)

INFORMATIONAL MATERIAL

- *Introduction to Computer Science using Java* http://chortle.ccsu.edu/java5/cs151java.html
  Bradley Kjell, 2006. Central Connecticut State University
  (Referred to as Kjell)

- College Board. *Labs* https://apcentral.collegeboard.org/courses/ap-computer-science-a/classroom-resources/lab-resource-page

Expected Proficiencies/Career and Life Skills

PROFICIENCIES:

- Become familiar with different searches and sorts algorithms
- Compare selection, insertion and merge sort
- Explore searching and sorting with arrays

LIFE SKILLS:

- Students will be able to compare different algorithms and choose the best for their programming needs

Formative & Summative Assessments

FORMATIVE:

- Hands-on lab work
- In-class discussions
- Quizzes
- Questioning and discussion

SUMMATIVE:

- Projects/Presentations
- End-of-unit or chapter tests
- End-of-term or semester exams

Resources (Websites, LMS, Google Classroom, documents, etc.)

- Lynda.com
- Canvas

- YouTube videos
- Learn.sparkfun.com
- Tutorialpoint.com

Suggested Time Frame : 8 weeks

UNIT 4

Content Area:	**AP Computer Science IV**	**Grade(s)**	**12**
Unit Plan Title:	**INTRODUCTION TO CYBERSECURITY** **I. What is cybersecurity? (week 33)** **1.** Cybersecurity **2.** Impact of cybersecurity **II. Digital Citizenship and Cyber Hygiene (week 34)** **1.** Digital Footprint and Reputation **2.** Cyberbullying **3.** Internet Safety **4.** Copyright **5.** Hacking Ethics **III. The ABCs of Cryptography (week 35)** **1.** Cryptography, Cryptology, Cryptanalysis **2.** Caesar Cipher, Cracking Caesar 3. Hash Functions **IV. Software Security (week 35)** **1.** Inside Web Apps **2.** **3.** Client. Server, Databases **4.** Data Exposure *Sample Student Activity* Why is digital citizenship and cyber hygiene important? What is the difference between Cryptography, Cryptology, and Cryptanalysis?		

NJSLS/CCTC Standard(s) Addressed	
CRP1. Act as a responsible and contributing citizen and employee. **CRP2.** Apply appropriate academic and technical skills. **CRP4.** Communicate clearly and effectively and with reason **CRP5.** Consider the environmental, social and economic impacts of decisions. **CRP7.** Employ valid and reliable research strategies. **CRP9.** Model integrity, ethical leadership and effective management. **CRP11.** Use technology to enhance productivity. **9.3. IT.4** Demonstrate positive cyber citizenry by applying industry accepted ethical practices and behaviors. **9.3. IT.8** Recognize and analyze potential IT security threats to develop and maintain security requirements. **9.3. IT.10** Describe the use of computer forensics to prevent and solve information technology crimes and security breaches. **9.3. IT-NET.2** Analyze wired and wireless network systems to determine if they meet specifications (*e.g.*, IEEE, power and security).	
Essential Questions (3-5)	
1. Why is digital citizenship and cyber hygiene important? 2. What is the difference between Cryptography, Cryptology, Cryptanalysis 3. What are the different ways of securing a network? 4. Why is "cybersecurity" important in modern day society?	
Anchor Text(s)	
Code HS – https://codehs.com/ **Reference Books**: • Network Security Essentials – volume 1 - second edition – ISECOM ISBN/EAN13: 0978520718 / 9780978520717 • Security Analysis Essentials – volume 2 - ISECOM ISBN/EAN13:0978520726 / 9780978520724 • Hacking Essentials – volume 3 – ISECOM ISBN/EAN13:0978520734 / 9780978520731	
Short & Informational Texts (3-5)	
INFORMATIONAL MATERIAL	

- **“**Computer Security Tutorial”
  https://www.tutorialspoint.com/computer_security/index.htm

- “Ethical Hacking and Cyber Security”
  https://www.tutorialspoint.com/ethical_hacking_and_cyber_security/index.asp

- “Cyber Security Strategies”
  https://www.tutorialspoint.com/information_security_cyber_law/cyber_security_strategies.htm

Expected Proficiencies/Career and Life Skills

PROFICIENCIES:

- Understand the impact of Cybersecurity
- Learn about hacking ethics
- Know the consequences of cyber bullying
- Familiar with Internet safety guidelines
- Learn about network hacks

LIFE SKILLS:

- Students will be able to learn and reinforce essential security skills to protect themselves against hacking.
- Students will learn about cyber safety
- Students will able to protect themselves against cyberbullying.

Formative & Summative Assessments

FORMATIVE:

- Hands-on lab work
- In-class discussions
- Quizzes
- Questioning and discussion

SUMMATIVE:

- Projects/Presentations
- End-of-unit or chapter tests

• End-of-term or semester exams
Resources (Websites, LMS, Google Classroom, documents, etc.)
• Lynda.com • Canvas • YouTube videos • Tutorialpoint.com
Suggested Time Frame : 3 weeks

III. INSTRUCTIONAL STATEGIES

- Lectures
- Cooperative learning
- Hands-on learning
- Researching information
- Homework and practice
- Debating
- Discussions
- Project-based learning
- Instructional videos (YouTube, Lynda.com)
- Technical writing
- Student goal setting
- Differentiated instruction
  - Assess students' learning using formative assessment
  - Recognition of diverse learners
  - Create a PowerPoint presentation summarizing the lesson.
  - Ongoing, formative assessment
  - Write to explore, think, learn, and improve comprehension.

IV. SCOPE AND SEQUENCE

I = Introduce **D = Develop** **R = Reinforce** **M = Master**	
Apply appropriate academic and technical skills.	I, D, R
Communicate clearly and effectively and with reason.	I, D, R
Demonstrate creativity and innovation.	I, D
Employ valid and reliable research strategies	I, D
Utilize critical thinking to make sense of problems and persevere in solving them.	I, D
Use technology to enhance productivity.	I, D, R
Work productively in teams while using cultural global competence.	I, D, R
Demonstrate effective professional communication skills and practices that enable positive customer relationships.	I, D
Use product or service design processes and guidelines to produce a quality information technology (IT) product or service	I, D
Analyze customer software needs and requirements.	I, D
Demonstrate the use of industry standard strategies and project planning to meet customer specifications.	I, D
Demonstrate the effective use of software development tools to develop software applications.	I, D
Apply an appropriate software development process to design a software application	I, D
Program a computer application using the appropriate programming language.	I
Demonstrate software testing procedures to ensure quality products.	I, D
Perform quality assurance tasks as part of the software development cycle.	I, D
Design, create and maintain a database.	I, D

V. COURSE TEXTBOOKS, INSTRUCTIONAL RESOURCES AND SOFTWARE

- *Blue Pelican Java* Charles E. Cook, Online Textbook
  ISBN: 1589397584
  http://www.bluepelicanjava.com

- *Multiple Choice and free response questions in preparation for AP CS A exam*
  ISBN: 978-1-934780-34-3

- *Java software Solutions* – 3rd Edition, Lewis, Loftus, Cocking
  ISBN: 978013
  http://www.bluepelicanjava.com

VI. STUDENT HANDOUT:

The goal of AP Computer Science IV is to give the students an in-depth understanding of SQL programming, and cyber security. This course also encompasses many different types of open-ended problems of a mathematical or business nature. Students will work on embedded systems like Arduino. All students will demonstrate the following skills:

- Critical thinking
- Decision making
- Software engineering
- Use of technologies
- Self-management skills
- Time-management skills
- Teamwork
- Divide and conquer

In order to apply these skills, the instructional strategies will incorporate solving a number of Lab Assignments.

PROFICIENCIES

- Describe the steps involved in java program compilation and execution
- Know the deference between primitive data and objects
- Able to create objects and use them
- Define the flow of control through a program
- Learn to use *if* statements
- Learn to use *while* and *for* statements
- Use method overloading and method overriding
- Define and use arrays
- Describe how arrays and array elements are passed as parameters
- Learn to use multidimensional arrays
- Examine the ArrayList class
- Derive new classes from existing class
- Add and modify methods in child classes
- Define inheritance, encapsulation and polymorphism.
- Become familiar with different searches and sorts algorithms
- Compare selection, insertion and merge sort
- Explore searching and sorting with arrays
- Understand the impact of Cybersecurity
- Learn about hacking ethics
- Know the consequences of cyber bullying
- Familiar with Internet safety guidelines
- Learn about network hacks